

BRITISH COLUMBIA
MINISTRY OF FORESTS

Tree Farm Licence 23

Issued to Pope & Talbot Ltd.

Rationale for Allowable Annual Cut (AAC) Determination

Effective August 31, 1999

Larry Pedersen
Chief Forester

Table of Contents

Objective of this Document.....	3
Description of the TFL.....	3
History of the AAC	3
New AAC determination.....	4
Information sources used in the AAC determination.....	4
Role and limitations of the technical information used.....	6
Statutory framework.....	6
Guiding principles for AAC determinations.....	6
The role of the base case	9
Timber Supply Analysis.....	10
Consideration of Factors as Required by Section 8 of the <i>Forest Act</i>	11
Land base contributing to timber harvest.....	11
- general comments.....	11
- non-forested, non-productive and non-commercial areas	12
- economic and physical operability	12
- unstable soils	13
- environmentally sensitive areas (ESAs).....	13
- estimates for roads, trails and landings	14
- non-merchantable and low productivity stands.....	14
Existing forest inventory	15
- inventory audit.....	15
- age-class distribution and species profile.....	15
Expected rate of growth	16
- aggregation procedures.....	16
- volume estimates for existing stands.....	16
- volume estimates for regenerated stands.....	16
- site productivity estimates	17
- operational adjustment factors (OAFs)	18
- minimum harvestable ages	18
- harvest profile and sequencing	19
Regeneration delay	19
Not-satisfactorily-restocked areas	20
Impediments to prompt regeneration	21
Silvicultural systems	21
Basic silviculture.....	21
Intensive silviculture	22
- genetic improvement	22
- fertilization	23
- juvenile spacing	23
- stand conversion treatments	23
- commercial thinning	23

Utilization standards	24
Decay, waste and breakage	24
Integrated resource management objectives	25
- non-timber resource inventories and assessments	25
- archaeological sites	25
- recreation	25
- wildlife habitat	26
- caribou habitat	26
- ungulate winter range	27
- identified wildlife	28
- riparian habitat	28
- watershed considerations	29
- green-up and adjacency	30
- visually sensitive areas	31
- biodiversity	32
Land use planning considerations	35
Twenty-year plan	36
Partitioned component of the harvest	37
Alternative harvest flows	38
Timber processing facilities	39
Minister's letters and memorandum	39
Community dependence	40
Public Involvement	40
First Nations	40
Unsalvaged losses	41
Reasons for decision	41
Implementation	44
Appendix 1: Section 8 of the <i>Forest Act</i>	45
Appendix 2: Section 4 of the <i>Ministry of Forests Act</i>	46
Appendix 3: Minister of Forests' letter of July 28, 1994	47
Appendix 4: Minister of Forests' memo of February 26, 1996	47

Objective of this Document

This document is intended to provide an accounting of the factors I have considered and the rationale I have employed as chief forester of British Columbia in making my determination, under Section 8 of the *Forest Act*, of the allowable annual cut (AAC) for Tree Farm Licence (TFL) 23. This document also identifies where new or better information is required for incorporation into future determinations.

Description of the TFL

TFL 23 is located in the south-east corner of the province, adjacent to the Arrow Lakes. The TFL is situated south of Glacier National Park, and extends from Valhalla Provincial Park in the east to Monashee Provincial Park in the west. The TFL is held by Pope and Talbot Ltd. (P&T) and is administered by the Arrow and Columbia Forest Districts which are both part of the Nelson Forest Region. Castlegar, Nakusp and Revelstoke are the principal communities associated with the TFL.

The forests of TFL 23 lie within the interior wet-belt and are distributed among the Interior Cedar-Hemlock (ICH), Interior Douglas-fir (IDF) and Engelmann Spruce-Subalpine Fir (ESSF) biogeoclimatic zones. The varied topography and climatic conditions support a variety of commercial tree species including Douglas-fir, western hemlock, Engelmann and white spruce, lodgepole pine, sub-alpine fir (balsam), western larch and western redcedar.

The total area used in the timber supply analysis for TFL 23 is 556 389 hectares of which 371 834 hectares (67 percent) are considered productive forest. The remaining 184 555 hectares are composed of non-productive areas including alpine areas, non-productive brush, rock, rivers, lakes and swamp. The timber harvesting land base—the area presently considered to be available for harvesting—is approximately 224 702 hectares or about 40 percent of the total TFL land base.

Road access to TFL 23 is provided by provincial highways running from Revelstoke to Castlegar, and from Vernon to Nakusp. Forestry, tourism, mining, agriculture and transportation are the principal economic activities in the region.

History of the AAC

TFL 23 was originally issued to Celgar Development Company Ltd. in 1955. At the time of Management Plan (MP) No. 1 the AAC was 379 446 cubic metres. During the 1960s and 1970s, the AAC was increased because of improved utilization of the timber resource and the expansion of pulpmill operations in the area. In 1970, ownership of the TFL was assigned to Skeena Kraft Ltd. and in 1991, it was assigned to Westshore Terminals Ltd., an affiliate of Westar Timber Ltd.

During the period of MP No. 7, the TFL was divided into two new licences. The southern portion of the original TFL was assigned to Pope & Talbot Ltd. on April 15, 1992. An interim AAC of 700 000 cubic metres per year—effective January 1, 1992—was determined for the new TFL 23, of which 80 700 cubic metres per

year were allocated to the Small Business Forest Enterprise Program (SBFEP). This AAC remained in effect until August 31, 1994 when the AAC was reduced to 680 000 cubic metres for the period of MP No. 8. This AAC included partitions of 75 000 cubic metres per year attributable to older (age class 8 and 9) hemlock-dominated forest types and 50 000 cubic metres per year attributable to stands not accessible using conventional harvesting systems.

New AAC determination

Effective August 31, 1999, the new AAC for TFL 23 will be 680 000 cubic metres—the same as the current AAC. This AAC includes 80 700 cubic metres administered under the SBFEP and a partition of 56 000 cubic metres per year attributable to the 'aerial' operability class.

This AAC will remain in effect until a new AAC is determined, which must take place within five years of this determination.

Information sources used in the AAC determination

Information considered in determining the AAC for TFL 23 includes the following:

- Statement of Management Objectives, Options and Procedures (SMOOP) for draft Management Plan No. 9, TFL 23, accepted September 2, 1997;
- Existing stand yield tables for TFL 23, accepted by BCFS Resources Inventory Branch, February 17, 1999;
- TFL 23 Inventory Audit, BCFS Resources Inventory Branch, 1995;
- Managed stand yield tables and site index curves for TFL 23, accepted by BCFS Research Branch, October 14, 1998;
- Timber Supply Analysis Information Package: TFL 23, Management Plan No. 9, Pope & Talbot Ltd. (prepared by Timberline Forest Inventory Consultants Ltd.), accepted July 3, 1998;
- Timber Supply Analysis Report: TFL 23, Management Plan No. 9, Pope & Talbot Ltd. (prepared by Timberline Forest Inventory Consultants Ltd.), accepted April 19, 1999;
- Twenty-Year Plan for TFL 23, accepted January 19, 1999;
- Management Plan No. 9 for TFL 23, Pope & Talbot Ltd., accepted December 17, 1998;
- Summary of public input solicited by the licensee regarding the contents of draft Management Plan No. 9;
- Letter from the Minister of Forests to the Chief Forester, dated July 28, 1994, stating the Crown's economic and social objectives;

- Memorandum from the Minister of Forests to the Chief Forester, dated February 26, 1996, stating the Crown's economic and social objectives regarding visual resources;
- Memorandum from the Deputy Ministers of Forests, and Environment, Lands and Parks, dated August 25, 1997, conveying government's objectives regarding the achievement of acceptable impacts of biodiversity management on timber supply;
- Memorandum from the Director of Timber Supply Branch of the Ministry of Forests, dated December 1, 1997 entitled Incorporating Biodiversity and Landscape Units in the Timber Supply Review;
- Memorandum of Understanding between the Ministry of Forests and Ministry of Environment, Lands and Parks (MELP) regarding instructions for the preparation of 1998 Forest Development Plans, dated October 2, 1997;
- Supplement to the Forest Development Plan Guidebook for the Nelson Forest Region and Columbia Forest District, 1998 - 2002 Forest Development Plan, dated October 22, 1997;
- Memorandum from the Chief Forester and Assistant Deputy Minister of Environment, Lands and Parks regarding procedures for identifying and approving existing ungulate winter ranges, dated August 6, 1998;
- Sterling Wood Group Inc. 1997. Predicting site index for forest stands in TFL 23 regenerated after logging including a review of the paper by Robert Bailey, Forest Resources Consultants.
- Revelstoke and Area Land Use Planning Minister's Advisory Committee (MAC) Draft Recommendations, dated October 1, 1997;
- Formal establishment of Landscape Units and Biodiversity Emphasis Options for the Arrow Forest District, dated April 8, 1998.
- Technical information provided through correspondence and communication among staff from the British Columbia Forest Service (BCFS) and the Ministry of Environment, Lands and Parks (MELP);
- Technical review and evaluation of current operating conditions through comprehensive discussions with BCFS and MELP staff, including the AAC determination meeting held in Victoria on April 20, 1999;
- *Forest Practices Code of British Columbia Act*, (as amended);
- *Forest Practices Code of British Columbia Act Regulations*, (as amended);
- *Forest Practices Code of British Columbia* guidebooks, BCFS and MELP;
- *Forest Practices Code, Timber Supply Analysis 1996*, BCFS and MELP;

Role and limitations of the technical information used

Section 8 of the *Forest Act* requires me as chief forester to consider biophysical as well as social and economic information in AAC determinations. A timber supply analysis, and the inventory and growth and yield data used as inputs to the analysis, typically form the major body of technical information used in AAC determinations. Timber supply analyses and associated inventory information are concerned primarily with biophysical factors—such as the rate of timber growth and definition of the land base considered available for timber harvesting—and with management practices.

However, the analytical techniques used to assess timber supply are simplifications of the real world. There is uncertainty about many of the factors used as inputs to timber supply analysis due in part to variations in physical, biological and social conditions, although ongoing science-based improvements in the understanding of ecological dynamics will help reduce some of this uncertainty.

Furthermore, technical analytical methods such as computer models cannot incorporate all of the social, cultural and economic factors that are relevant when making forest management decisions. Therefore, technical information and analysis do not necessarily provide the complete answer or solution to forest management problems such as AAC determination. The information does, however, provide valuable insight into potential impacts of different resource-use assumptions and actions, and thus forms an important component of the information I must consider in AAC determinations.

In making the AAC determination for TFL 23, I have considered known limitations of the technical information provided, and I am satisfied that the information provides a suitable basis for my determination.

Statutory framework

Section 8 of the *Forest Act* requires the chief forester to consider particular factors in determining AACs for timber supply areas (TSAs) and TFLs. Section 8 is reproduced in full as Appendix 1.

Guiding principles for AAC determinations

Rapid changes in social values and in our understanding and management of complex forest ecosystems mean that there is always some uncertainty in the information used in AAC determinations. In making a large number of determinations for many forest management units over extended periods of time, administrative fairness requires a reasonable degree of consistency of approach in incorporating these changes and uncertainty. To make my approach in these matters explicit, I have set out the following body of guiding principles. If in some specific circumstance it may be necessary to deviate from these principles, I will provide a detailed reasoning in the considerations that follow.

Two important ways of dealing with uncertainty are:

- (i) minimizing risk, in respect of which in making AAC determinations, I consider the uncertainty associated with the information before me, and attempt to assess the various potential current and future social, economic and environmental risks associated with a range of possible AACs; and
- (ii) redetermining AACs frequently, to ensure they incorporate current information and knowledge—a principle that has been recognized in the legislated requirement to redetermine AACs every five years. The adoption of this principle is central to many of the guiding principles that follow.

In considering the various factors that Section 8 of the *Forest Act* requires the Chief Forester to take into account in determining AACs, I attempt to reflect as closely as possible operability and forest management factors that are a reasonable extrapolation from current practices. It is not appropriate to base my decision on unsupported speculation with respect either to factors that could work to increase the timber supply—such as optimistic assumptions about harvesting in unconventional areas, or using unconventional technology, that is not substantiated by demonstrated performance—or to factors that could work to reduce the timber supply, such as integrated resource management objectives beyond those articulated in current planning guidelines or the *Forest Practices Code* (the Code).

The *Forest Practices Code of British Columbia Regulations* were approved by the Lieutenant Governor in Council on April 12, 1995, and released to the public at that time. The *Forest Practices Code of British Columbia Act* was brought into force on June 15, 1995.

Although the Code has been fully implemented since the end of the transition period on June 15, 1997, the timber supply implications of some of its provisions, such as those for landscape-level biodiversity, still remain uncertain, particularly when considered in combination with other factors. In each AAC determination I take this uncertainty into account to the extent possible in the context of the best available information.

As British Columbia progresses toward completion of strategic land use plans, the eventual timber supply impacts associated with the land-use decisions resulting from the various planning processes—including the Commission on Resources and Environment (CORE) process for sub-regional plans, the Protected Areas Strategy or the Land and Resource Management Planning (LRMP) process—are often discussed in relation to current AAC determinations. Since the outcomes of these planning processes are subject to significant uncertainty before formal approval by government, it has been and continues to be my position that in determining AACs it would be inappropriate for me to attempt to speculate on the impacts on timber supply that will eventually result from land-use decisions that have not yet been taken by government. Thus I do not consider the possible impacts of existing or anticipated recommendations made by such planning processes, nor do I attempt to anticipate any action the government could take in response to such recommendations.

Moreover, even where government has made land-use decisions—such as the 1995 *Kootenay Boundary Land-Use Plan*—it may not always be possible to analyze the full timber supply impact in an AAC determination. In most cases, government's land-use decisions must be followed by detailed implementation decisions. For example, a land-use decision may require the establishment of resource management zones and resource management objectives and strategies for these zones. Until such implementation decisions are made it would be impossible to fully assess the overall impacts of the land-use decision. Nevertheless, the legislated requirement for five-year AAC reviews will ensure that future determinations address ongoing plan implementation decisions. However where specific protected areas have been designated by legislation or by order in council, these areas are deducted from the timber harvesting land base and are no longer considered to contribute to the timber supply in AAC determinations.

For TFL 23, clarification has been provided on many aspects of land and resource use by government's approval in 1995 of the *Kootenay-Boundary Land-Use Plan* (KBLUP) and a subsequent implementation strategy. In addition, in 1995 the Revelstoke and Area Land-Use Planning Minister's Advisory Committee (MAC) was created to make recommendations to government on how the KBLUP should be implemented locally in the Revelstoke area—an area which includes part of TFL 23. The MAC strategy has not yet been approved by government and until such time, only practices that have been approved and implemented will be reflected in the timber supply review, along with changes to the land base resulting from government's establishment of new protected areas.

Forest Renewal BC funds a number of intensive silviculture activities that have the potential to affect timber supply, particularly in the long term. As with all components of my determinations, I require sound evidence before accounting for the effects of intensive silviculture on possible harvest levels. Nonetheless, I will consider information on the types and extent of planned and implemented practices as well as relevant scientific, empirical and analytical evidence on the likely magnitude and timing of any timber supply effects of intensive silviculture.

Some have suggested that, given the large uncertainties present with respect to much of the data in AAC determinations, any adjustments in AAC should wait until better data are available. I agree that some data are not complete, but this will always be true where information is constantly evolving and management issues are changing. Moreover, in the past, waiting for improved data created the extensive delays that resulted in the urgency to redetermine all the AACs in the province—many of which were outdated—between 1992 and 1996. In any case, the data and models available today are improved from those available in the past, and will undoubtedly provide for more reliable determinations.

Others have suggested that, in view of data uncertainties, I should immediately reduce some AACs in the interest of caution. However, any AAC determination I make must be the result of applying my judgement to the available information and taking any uncertainties into account. Given the large impacts that AAC determinations can have on

communities, no responsible AAC determination can be made solely on the basis of a response to uncertainty. Nevertheless, in making my determination, I may need to make allowances for risks that arise because of uncertainty.

With respect to First Nations' issues, I am aware of the Crown's legal obligations resulting from recent court decisions including those in the Supreme Court of Canada. The AAC that I determine should not in any way be construed as limiting those obligations under these decisions, and in this respect it should be noted that my determination does not prescribe a particular plan of harvesting activity within TFL 23.

With respect to future treaty decisions, as with other land-use decisions it would be inappropriate for me to attempt to speculate on the impacts on timber supply that will result from decisions that have not yet been taken by government.

Overall, in making AAC determinations, I am mindful of my obligation as steward of the forest land of British Columbia, of the mandate of the Ministry of Forests as set out in Section 4 of the *Ministry of Forests Act*, and of my responsibilities under the *Forest Practices Code of British Columbia Act*.

The role of the base case

In considering the factors required under Section 8 of the *Forest Act* to be addressed in AAC determinations, I am assisted by timber supply forecasts provided to me through the work of the Timber Supply Review program for TSAs and TFLs. For TFLs, the analysis work is carried out by licensees and reviewed and approved by BCFS staff.

For each AAC determination a timber supply analysis is carried out using an information package including data and information from three categories: land base inventory, timber growth and yield, and management practices. Using this set of data, and a computer model, timber supply forecasts are produced. These include sensitivity analyses to assess the timber supply effects of uncertainties or changes in various assumptions around a baseline option, normally referred to as the "base case" forecast.

The base case forecast may incorporate information about which there is some uncertainty. Its validity, as with all the other forecasts provided, depends on the validity of the data and assumptions incorporated into the computer model used to generate it. Therefore, much of what follows in the considerations outlined below is an examination of the degree to which all the assumptions made in generating the base case forecast are realistic and current, and the degree to which its predictions of timber supply must be adjusted, if necessary, to more properly reflect the current situation.

These adjustments are made on the basis of informed judgement, using current information available about forest management, which may well have changed since the original information package was assembled. Forest management data is particularly subject to change during periods of legislative or regulatory change, such as the enactment of the Forest Practices Code, or during the implementation of new policies, procedures, guidelines or plans.

Thus it is important to remember, in reviewing the considerations which lead to the AAC determination, that while the timber supply analysis with which I am provided is integral to those considerations, the AAC determination itself is not a calculation but a synthesis of judgement and analysis in which numerous risks and uncertainties are weighed. Depending upon the outcome of these considerations, the AAC determined may or may not coincide with the base case forecast. Judgements that may in part be based on uncertain information are essentially qualitative in nature and, as such, subject to an element of risk. Consequently, once an AAC has been determined, no additional precision or validation may be gained by attempting a computer analysis of the combined considerations to confirm the exact AAC determined.

Timber Supply Analysis

The timber supply analysis for TFL 23 was conducted by Timberline Forest Inventory Consultants Ltd. on behalf of the Pope & Talbot Ltd. Timberline used a proprietary computer simulation forest estate model called Critical Analysis by Simulation of Harvesting (CASH6). Based on previous experience examining results from this model, as well as my staff's review of the model, I am satisfied that it is capable of providing a reasonable projection of timber supply.

P&T presented two different analysis options in their timber supply analysis, based on a combination of management and land base assumptions. The licensee's "Base Case—KBLUP Caribou Habitat Option" considered the landscape units and biodiversity emphasis defined for TFL 23, accounted for new protected areas from the Kootenay Boundary Land Use Plan (KBLUP), and incorporated special management for important wildlife including the KBLUP caribou habitat definitions.

P&T presented a second option (Caribou Habitat Option) which employed all the assumptions of the previous option except that the area identified as caribou habitat was based on the licensee's own field studies. The licensee regarded this option as preliminary in nature and included it to demonstrate the potential to mitigate the timber supply impacts associated with maintenance of caribou habitat.

The licensee's "Base Case—KBLUP Caribou Habitat Option" best reflects current resource management strategies for TFL 23 under MP No. 9 and therefore represents the base case (discussed above under "The role of the base case").

For TFL 23, the base case projected an initial harvest rate of 680 000 cubic metres per year—the same as the existing AAC. In the base case, the initial harvest level was maintained for four decades, followed by a decline of ten percent to 612 000 cubic metres per year in decade five and a further seven percent decline to 572 000 cubic metres per year in decade six. This harvest level was maintained for four decades and then increased to a long term harvest level of 634 000 cubic metres per year in decade ten.

In the timber supply analysis, sensitivity analyses were provided to assess the risk to timber supply resulting from uncertainty in data assumptions and estimates, and these have assisted me in considering the factors leading to my determination. As discussed

and qualified below, I am satisfied that the base case provides a suitable reference point from which to assess the timber supply for this determination.

Consideration of Factors as Required by Section 8 of the *Forest Act*

Section 8 (7)

In determining an allowable annual cut under this section the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider

- (a) the rate of timber production that may be sustained on the area, taking into account
- (i) the composition of the forest and its expected rate of growth on the area

Land base contributing to timber harvest

- general comments

The total area of TFL 23 as reported in the timber supply analysis is 556 389 hectares. Productive forested areas, excluding non-forest and non-productive areas account for 371 834 hectares or approximately 67 percent of the total TFL area.

As part of the process used to define the timber harvesting land base, a series of deductions was made from the productive forest land base. These deductions account for factors which reduce the forest area available for harvesting for economic or ecological reasons. In timber supply analysis, assumptions and if necessary, projections, must be made about these factors prior to quantifying appropriate areas to be deducted from the productive forest area in order to derive the timber harvesting land base. For TFL 23, the timber harvesting land base used in the base case harvest forecast was 224 702 hectares, or approximately 40 percent of the total TFL area. Specific land base reduction factors and the supporting assumptions are described below.

In reviewing this process I am aware that some areas may have more than one classification. For example, environmentally sensitive areas (ESAs) may also lie within riparian areas. To ensure the accuracy of the timber harvesting land base derivation, it is imperative that no deduction be made more than once in respect of the same area of land, by virtue of it or of some part of it coming under more than one classification. Hence, the deduction reported in the analysis or the AAC rationale for a given factor does not necessarily reflect the total area with that classification; some portion of it may have been deducted earlier under another classification. For TFL 23, I acknowledge that the licensee used the above approach in the timber supply analysis to appropriately determine the timber harvesting land base and I find the results to be reasonable for use in this determination.

- non-forested, non-productive and non-commercial areas

Non-forested areas on TFL 23 include alpine areas, non-productive brush, rock, rivers, lakes, swamp, and other non-productive areas. Based on the TFL inventory, the licensee excluded 184 555 hectares of non-forested and non-productive areas as well as 198 hectares of non-commercial brush from contributing to the TFL 23 timber harvesting land base. Standard procedures were followed in the analysis to exclude these areas.

- economic and physical operability

Terrain characteristics, access and economic criteria typically affect the areas on which the licensee may potentially conduct harvesting operations. For the timber supply analysis, the licensee employed updated operability mapping to quantify areas physically and economically accessible to harvesting operations. The mapping defined three operability classes as follows: 'conventional', which comprise terrain accessible using ground-based or conventional yarding equipment (244 640 hectares of the total TFL area); 'aerial', which denotes areas where helicopters or long-line systems are required (24 194 hectares); and 'inaccessible', which denotes areas not available for harvesting because of physical or economic limitations (274 550 hectares).

In the timber supply analysis, the licensee excluded the 'inaccessible' areas from contributing to the timber harvesting land base (100 719 hectares after previous deductions). District staff have approved the revised operability mapping and the deductions applied in the analysis.

P&T provided a sensitivity analysis to show that those areas classified as 'aerial' can contribute approximately 56 000 cubic metres per year to the annual harvest on TFL 23 over the forecast period. During the past four years P&T has harvested an average of approximately 21 000 cubic metres per year from non-conventional areas. The licensee maintains that this recent performance demonstrates that the company can successfully operate in these areas.

I note that the AAC under MP No. 8 included a partition of 50 000 cubic metres from areas inaccessible using conventional harvesting systems (discussed below under Partitioned component of the harvest). While P&T have demonstrated operations in those areas classified as 'aerial', BCFS district staff suggest that maintaining such harvesting operations will be challenging under present economic conditions.

I have reviewed the information used by the licensee to define its operability classification on TFL 23. I find that the criteria and assumptions applied reasonably reflect current performance noting that under MP No. 8, the licensee has attained about 41 percent of the 50 000 cubic metre partition for non-conventional areas. I have also considered that in the event that no future harvesting is conducted within those areas classified as 'aerial', the initial timber supply can still be maintained for up to three decades. I therefore accept the information used in the base case as the best available and suitable for this determination. I have further discussed the implications of harvesting

within the areas classified as 'aerial' below under Partitioned component of the harvest

- unstable soils

TFL 23 includes areas where harvesting operations are restricted because of unstable soils. To identify these areas, the licensee used reconnaissance-level terrain stability mapping as well as slope class information. Areas identified as unstable (terrain class IV) or highly unstable (terrain class V), and occurring on slopes greater than 75 percent were considered unavailable for harvesting. A total of 25 228 hectares of these areas were identified. After accounting for previous deductions, an additional 4764 hectares were excluded from the timber harvesting land base to account for sensitive soils.

The BCFS regional geomorphologist reviewed the methodology used in the timber supply analysis. While the approach does not accurately identify specific areas on the TFL that are unavailable to timber harvesting because of soil sensitivity considerations, he advises that the proportion of area excluded is adequate for timber supply analysis purposes. Sensitivity analysis provided by the licensee showed that altering the maximum slope criteria from 75 percent to 60 percent does not significantly change the estimate of the area of unstable soils nor present a risk to timber supply compared to the base case forecast.

Having reviewed the information, I find that the deductions applied in the analysis reasonably account for the area of sensitive soils and have made no further adjustments. During the term of MP No. 9, I encourage the licensee to work closely with the BCFS regional geomorphologist to further refine terrain stability mapping on TFL 23. Any new information can be incorporated into future timber supply analyses.

- environmentally sensitive areas (ESAs)

Some areas are environmentally sensitive or significantly valuable for resources other than timber. In the TFL 23 timber supply analysis ESA deductions were limited to difficult-to-regenerate (Ep) areas. A total of 53 684 hectares of Ep areas was identified in the licensee's resource inventories. Accounting for previous deductions, 2937 hectares of Ep areas were excluded from the timber harvesting land base in the timber supply analysis. BCFS District and MELP staff concur with the reductions applied in the timber supply analysis.

The deductions applied in the analysis adequately reflect current practice and I therefore accept them for this determination. However, I note that there may be significant overlap between the Ep areas and those areas previously considered to be inoperable. I therefore request that the licensee refine the Ep classification on TFL 23 to identify any areas with potential regeneration concerns, paying particular attention to the area within the 'aerial' operability classification. Any new information can be included in subsequent analyses.

- estimates for roads, trails and landings

In the timber supply analysis, the licensee deducted 5333 hectares from the productive forest to account for 3293 kilometres of existing roads on TFL 23. Average road widths were based on the estimated distribution of road classes in the licensee's previous 20-year plan. Using a computer mapping technique, the licensee applied these road widths to the existing road lengths to estimate the total area of existing roads.

Existing trails and landings were not captured in the licensee's database. To account for these areas, four percent (3118 hectares) of the existing harvested areas were permanently excluded from contributing to the timber harvesting land base.

To derive the deduction for future roads, trails and landings, the licensee first reviewed the 20-year plan for the licence area. At the end of the 20-year period, P&T expects that the resulting road network will access all areas of the TFL. Using an average road width of 10.2 metres, the licensee estimates that an additional 1560 hectares of permanent roads will be required to complete the road network on the licence area. No reductions were made for future construction of trails and landings since current practice on the TFL includes site rehabilitation of all temporary access structures.

Based on their knowledge of local conditions and past performance on the TFL, BCFS Arrow and Columbia Forest District staff agree that the assumptions and estimates are reasonable. Having reviewed the information, I am also satisfied that the estimates of roads, trails and landings are acceptable and in the absence of better information, find them reasonable for this determination. I note that accurate estimates of future roads, trails and landings are difficult to generate but encourage the licensee to further review and refine their methodology in time for the next analysis. I also recommend the licensee monitor their performance on the rehabilitation of temporary access structures to ensure these areas are fully returned to timber production. Any new information will be considered in subsequent determinations.

- non-merchantable and low productivity stands

In the timber supply analysis, five classes of stands were removed from the timber harvesting land base to account for low productivity and non-merchantable stands that will not be harvested. Deciduous-leading stands, old (older than 140 years) balsam stands and a proportion of old hemlock-leading stands were removed from the timber harvesting land base. Those stands with a site index less than 8.0 metres as well as all stands designated as Alpine Tundra Parkland were also excluded.

P&T provided sensitivity analyses to demonstrate the impact on timber supply of varying the low productivity and non-merchantable classification. Applying site index 9.0 as the minimum productivity limit instead of site index 8.0, showed a medium- and long-term reduction to the harvest forecast of three and one percent respectively compared to the base case. Conversely, including old hemlock and balsam-leading stands in the timber harvesting land base increased medium- and long-term timber supply by two and one

percent respectively compared to the base case harvest forecast. Both sensitivity analyses showed no impact on the short-term harvest forecast.

BCFS District staff note that the assumptions used in the analysis broadly reflect current practice on TFL 23. I have examined the criteria and method used to account for non-merchantable and low productivity stands and have reviewed the associated sensitivity analyses. For the purposes of this determination I accept the criteria used in the base case as suitable for this determination and have made no further adjustments.

Existing forest inventory

- inventory audit

A re-inventory of TFL 23 consisting of new aerial photography and field work was completed in 1990. The re-inventory upgraded the 1974 inventory to 1990 BCFS standards. For the analysis the forest cover inventory was updated for disturbance and growth to December 31, 1997.

An inventory audit of TFL 23 was completed by BCFS Resources Inventory Branch in 1995. The audit found no statistical differences between the ground-based and the audit volume estimates of mature stands. Audit results for the immature component of the inventory also suggested that the site index assignments for young stands were acceptable.

The forest cover inventory used in the base case is the best available information and therefore suitable for this determination.

- age-class distribution and species profile

Approximately four percent of the timber harvesting land base is covered by stands more than 250 years old. About 28 percent of stands on the timber harvesting land base are between 140 and 250 years old, 29 percent are between 80 and 140 years old, and approximately 39 percent are younger than 80 years. Historically, fire has played a significant role in determining the current age class structure of the TFL.

The forests of TFL 23 consist primarily of Douglas-fir-, hemlock- and spruce-dominated stands. These stand types comprise 26, 23 and 16 percent of the timber harvesting land base respectively. Pine-, redcedar-, balsam-, and larch-dominated stands constitute a further 12, seven, nine, and seven percent of the TFL 23 timber harvesting land base.

Expected rate of growth

- aggregation procedures

For the timber supply analysis, the inventory for TFL 23 was aggregated into analysis units based on species composition, site index, age, and silvicultural regime. Analysis units for existing stands were divided into two age classes (stands over 140 years and stands 26 to 140 years) to better account for differences in site productivity estimates which are more difficult to estimate in older stands. Species mixtures used to represent future managed stands were based on current silviculture objectives for TFL 23. I have reviewed the aggregation procedures and find they adequately capture the productivity of the unit. I therefore find them suitable for use in this determination.

- volume estimates for existing stands

The licensee used the Variable Density Yield Projection (VDYP) model to generate volume estimates for existing stands over 25 years old; younger stands were assumed to be managed. VDYP is based on information gathered from a large number of sample plots throughout the province, and is generally accepted in British Columbia as an adequate model for projecting volumes in existing natural stands. As a general rule in making AAC determinations, and in the absence of statistically valid contradictory evidence for a particular area, I rely on VDYP estimates for existing natural stands.

I note that deciduous species are not recovered during the licensee's harvesting operations. In the analysis, volumes attributable to hardwood species were therefore appropriately excluded from stands composed of predominately coniferous species. Volume estimates for existing stands were reviewed and approved for use in the analysis by BCFS Resources Inventory Branch staff.

An inventory audit was conducted on TFL 23 to determine the overall accuracy of the inventory. As discussed above under *inventory audit*, the audit found no statistically significant differences between the inventory volumes and those derived using VDYP.

I note the licensee followed recognized procedures. Having reviewed the methods used, and noting the results of the inventory audit, I therefore accept the estimates of existing stand volumes used in the base case as suitable for this determination.

- volume estimates for regenerated stands

In the timber supply analysis P&T developed volume estimates for existing stands 25 years of age and younger, and all future regenerated stands using the Table Interpolation Program for Stand Yields (TIPSY). All yield tables were reviewed and approved by BCFS Research Branch staff for use in the analysis. Future stands were assumed to regenerate to the species combinations consistent with management objectives using standard procedures.

The licensee provided a sensitivity analysis to show the impacts of varying regenerated stand yields by 10 percent. The analysis showed that long-term timber supply is proportionately sensitive to changes in regenerated stand yield estimates. However, I have no evidence that suggests that regenerated stand volume estimates are either over- or under-estimated and therefore accept them as modelled in the base case for use in this determination.

- site productivity estimates

Inventory data includes estimates of site productivity for each forest stand, expressed in terms of a site index. The site index is based on the stand's height as a function of its age. The productivity of a site largely determines how quickly trees grow. This in turn affects the time seedlings will take to reach green-up conditions, the volume of timber that can be produced, and the ages at which a stand will satisfy mature forest cover requirements and reach a merchantable size.

In general, in British Columbia, site indices determined from younger stands (i.e. less than 31 years old), and older stands (i.e. over 150 years old) may not accurately reflect potential site productivity. In young stands, growth often depends as much on recent weather, stocking density and competition from other vegetation, as it does on site quality. In old stands, which have not been subject to management of stocking density, the trees used to measure site productivity may have grown under intense competition or may have been damaged, and therefore may not reflect the true growing potential of the site. This has been verified in several areas of the province where studies—known as the old-growth site index or OGSi project—suggest that actual site indices may be higher than those indicated by existing data from mature forests. In recent years it has been concluded consistently from such studies that site productivity has generally been underestimated; managed forest stands tend to grow faster than projected by inventory-based site index estimates from mature and old-growth stands.

For the TFL 23 base case, site index values based on leading species, age and height were assigned to natural stand polygons using standard BCFS site index curves. The licensee applied an area-weighted average of these site indices to generate the corresponding yield table for each analysis unit. No OGSi adjustments were applied in the base case. However, the licensee provided a sensitivity analysis to show the impact on timber supply of applying general provincial OGSi adjustment equations to all stands older than 140 years. The results of the sensitivity analysis indicated significant increases in the medium-term and a 12 percent increase in the long-term timber supply compared to the base case harvest forecast.

Based on the findings of OGSi studies and the results of sensitivity analyses elsewhere in the province, I accept that there is a high likelihood that future stand yields may be significantly underestimated in the medium and long terms and I have considered this in my "Reasons for decision". I note that the site indices of existing managed stands were not adjusted in the sensitivity analysis. While no specific information is available for TFL 23, evidence in other management units suggests that the site indices of these stands may also be underestimated.

I acknowledge P&T's plan to review site indices on TFL 23 and also encourage the licensee to further refine site index assignments, including those for existing managed stands before the next determination.

- operational adjustment factors (OAFs)

Operational adjustment factors (OAFs) are applied during timber supply analysis to account for losses of timber volumes in managed stands as a result of particular operational conditions. The VDYP model used to project volumes for existing stands also incorporates estimates of volume of wood lost to decay, waste and breakage, as is discussed later in this rationale under *decay, waste and breakage*.

For managed stands, the TIPSYP model incorporates OAFs that account for anticipated decay, waste and breakage. Two OAFs are applied to the yield projections for managed stands. OAF 1 is intended to account for small, unmappable openings in stands as a result of losses from endemic populations of insects and diseases, holes in stocking and unidentified risks. OAF 2 accounts for age-related losses such as decay and for waste and breakage during harvest.

For TFL 23, the licensee applied standard OAFs to the yield projections for regenerated stands used in the timber supply analysis. P&T applied a 15 percent OAF to account for small non-productive areas and/or irregular spacing (OAF 1), and a five percent OAF to account for decay and age-related losses such as waste and breakage during harvest (OAF 2). Standard procedures were used and I accept the licensee's assumptions regarding OAFs as appropriate for use in this determination.

- minimum harvestable ages

Minimum harvestable age is an estimate of the earliest age at which a stand will reach a harvestable condition. Changing the minimum harvestable age generally affects when second growth will be available for harvest and, accordingly, the rate at which existing stands may be harvested. In practice, many forest stands will be harvested at different ages than the minimum due to constraints on harvesting which arise from managing for other forest values such as visual quality, wildlife habitat, or as a result of other operational considerations.

In the base case, the licensee assumed that stands are eligible for harvest when they are near to culmination age. Specifically, this was assumed to be the youngest age when mean annual increment (MAI) increased by less than 0.05 cubic metres per hectare per year. On TFL 23 minimum harvestable ages for both existing and managed stands ranged between 60 and 150 years. The corresponding volume ranges were 128 to 415 cubic metres per hectare for existing stands and 135 to 504 cubic metres per hectare for regenerated stands.

A sensitivity analysis provided by the licensee showed that medium-term timber supply is sensitive to changes in the minimum harvestable age of managed stands. Increasing the minimum harvestable age by ten years reduces medium-term timber supply compared to the base case projection. A corresponding reduction in minimum harvestable age increases medium-term timber supply and enables the current harvest level to be maintained for an additional two decades compared to the base case harvest forecast.

I have reviewed the assumptions used to model minimum harvestable age on TFL 23. I acknowledge that predicting the age at which stands may be harvested in the future is difficult and subject to considerable uncertainty. It is likely that some stands could be harvested below culmination age, a practice which would increase timber supply in the medium term. Having considered the methodology applied in the analysis, I accept the minimum harvestable ages modelled in the base case as satisfactory for use in this determination. However, I note that the impact of varying minimum harvestable ages on medium-term timber supply is significant. I recommend the licensee review the assumptions around the minimum harvestable age and operational standards used in the analysis giving due consideration to volume and value criteria. Any results should be incorporated into future determinations.

- harvest profile and sequencing

In the timber supply analysis, the licensee did not assume stands would be harvested according to a specific species profile. Rather, age was used to select stands for harvest with oldest stands being harvested first.

Although no other explicit consideration was given to modelling harvest profile, I note that the licensee's operational harvesting priorities include salvage considerations, sawmill requirements, stagnant stands and partition requirements. While I have reviewed the approach used and find it adequate for this determination, I suggest the licensee incorporate more detailed operational criteria to the extent possible in the next determination.

- (ii) **the expected time that it will take the forest to become re-established on the area following denudation:**

Regeneration delay

Regeneration delay is the period between harvesting and the time at which an area becomes occupied by a specified minimum number of acceptable, well-spaced seedlings. In the timber supply analysis for TFL 23, the licensee assumed a two-year regeneration delay for all species.

With the exception of not-satisfactorily-restocked (NSR) areas (described below), BCFS district staff agree that the regeneration delays applied in the timber supply analysis adequately reflect current practice. A sensitivity analysis provided by the licensee showed that timber supply is insensitive to changes in regeneration delay. Having

reviewed the assumptions used in the analysis and the sensitivity analysis results, I accept the regeneration delays applied to adequately restocked areas for use in this determination. I have discussed the specific implications of the regeneration assumptions in NSR areas in the section below.

Not-satisfactorily-restocked areas

NSR areas are areas of productive forest land that have been denuded and have failed, partially or completely, to regenerate either naturally or by planting or seeding to the specified or desired free growing standards for the site. These areas consist of "backlog" NSR—areas in which harvesting or other disturbance occurred before 1987—and "current" NSR.

According to P&T's resource inventories, the TFL 23 timber harvesting land base includes an estimated 6165 hectares of NSR areas. In the timber supply analysis, both the current and backlog NSR areas were assumed to regenerate within two years. However, the licensee contends that a significant amount of this area was in fact already sufficiently restocked at the time of the analysis. A recent examination of silviculture records supports this assertion and suggests that approximately 4000 hectares of NSR areas—3400 hectares of current NSR and 600 hectares of backlog NSR—exist on the TFL 23 timber harvesting land base.

I note that while some of the 600 hectare *backlog* NSR area may be regenerated within two years, regeneration of stands occupying a portion of this area is likely to take up to three years longer than was assumed in the analysis. As a result, in the model some future stands will be available for harvest up to three years ahead of schedule.

I have discussed the assumptions with BCFS district staff and have considered the likelihood that the total NSR area assumed in the analysis may be overestimated by approximately 2000 hectares. I note that using the more current estimate of NSR area may slightly improve short- and medium-term timber supply since stand growth in these areas will be more advanced than represented in the analysis. However, I also observe that regeneration of backlog NSR areas is, on average, expected to take more than the two years that was assumed in the base case. This offsets to some degree the potential improvement in short- and medium-term timber supply suggested by the over-estimation in total NSR area.

Having considered the combined effect of these two influences, the relative size of the NSR area (compared to the timber harvesting landbase) as well as the results of the licensee's sensitivity analysis, I conclude that the uncertainty in the size and regeneration schedules of NSR areas presents no risk to timber supply. I therefore accept the accounting of NSR areas as adequate for this determination.

Impediments to prompt regeneration

As described previously under environmentally sensitive areas (ESAs), the licensee excluded a total of 2937 hectares to account for difficult-to-regenerate areas. I accept these deductions for use in this determination, with the recommendation noted previously that the licensee review the classification before the next determination.

(iii) silvicultural treatments to be applied to the area:

Silvicultural systems

Clearcutting with reserves is the primary silvicultural system practiced on TFL 23. Reserves are intended to contribute to wildlife, riparian, visual and biodiversity values and in the analysis, they were excluded from contributing to the timber harvesting land base. While currently employed to a limited extent, the licensee expects that partial cutting will account for approximately ten percent of harvesting in the future. Partial cutting is used primarily in areas where maintaining visual quality and ungulate winter range are important management objectives.

In the timber supply analysis, a clearcutting system was assumed both for deriving timber yield estimates and for representing stand regeneration. I acknowledge that while methods to more accurately reflect partial cutting systems in growth and yield models and timber supply analyses are currently being developed, there is still considerable uncertainty in the methods used to model these systems. Due to the proportionately small area that is currently harvested using systems other than clearcutting, I am satisfied that this factor does not introduce significant risk into this determination. As the area harvested using partial cutting systems increases, and advanced modelling techniques become available, these will be considered in future analyses.

Basic silviculture

Basic silviculture on TFL 23 includes site preparation, planting of suitable species, and treatments (e.g., brushing) to ensure that regenerated areas achieve free-growing status within a specified time.

In the timber supply analysis, all stands were assumed to regenerate to preferred species combinations assigned by the licensee through a combination of planting and natural regeneration. Stands were modelled with an initial stocking density of 1600 stems per hectare. District staff indicate that the intended assumptions used in the analysis adequately reflect current practice.

However, during a review of the regeneration assumptions, BCFS timber supply branch staff noted that approximately four percent of the timber harvesting land base were modelled using TIPSy-generated yield curves whose species composition did not match the species mix intended by the licensee. As a result, culmination age of these stands occurs, on average, approximately ten years later in the model than was intended.

Having reviewed the methodology and assumptions used in the analysis and discussed them with BCFS staff, I have concluded as follows. I note that the small difference between the intended species composition and the actual species combinations applied in the analysis influences the age at which stands are available for harvest. Some second growth stands may be available for harvest sooner than was assumed in the analysis. However, the affected area represents only a small proportion of the timber harvesting land base and the impact on the harvest forecast depicted in the base case is unlikely to be significant.

I also note that minimum harvestable ages are subject to considerable uncertainty and depend on many factors including economic criteria; the age at which these stands are actually harvested is only partially influenced by a stand's regeneration regime. In summary, I accept the information as adequate for use in this determination and have made no further adjustments.

Intensive silviculture

Intensive silviculture activities include commercial thinning, juvenile spacing, pruning, fertilization, and genetic improvement. With the exception of genetic improvement, intensive silviculture is practiced to a limited extent on TFL 23. I will discuss these treatments below under their appropriate sections.

- genetic improvement

Genetically improved planting stock for many commercial tree species is currently being used across the province. The aim of tree improvement is to breed trees with increased growth rates, improved wood properties and greater resistance to insect pests and diseases. On TFL 23 the licensee uses a significant amount of improved seed—currently approximately 55 percent of lodgepole pine and 100 percent of spruce reforestation requirements are met using improved seed. By 2009, P&T expects that 79 percent of its planting program will employ genetically improved planting stock with a projected genetic gain of 14 percent.

To account for the use of improved seed, P&T applied a three percent increase in volume to all future managed (TIPSY) yield tables. I acknowledge P&T's intention to expand the deployment of genetically-improved seed and note that the assumptions used in the base case are below the stand yields expected by the licensee. I agree that in future, average genetic gain of reforested areas on TFL 23 is likely to be significantly higher than the gain applied in the base case and note that the licensee's expansion plans are consistent with provincial seed production objectives.

Having reviewed the assumptions as well as the licensee's sensitivity analysis described above under *volume estimates for regenerating stands*, I conclude that long-term timber supply may be underestimated by an uncertain amount on account of this factor. Because of the increased growth rates associated with genetically improved stock, its use may also reduce the time required to achieve green-up age as well as minimum harvestable age.

Both these actions may increase timber supply in the medium term by improving flexibility within constrained areas. I have discussed these implications below in my "Reasons for decision".

- fertilization

No areas of TFL 23 have been fertilized and currently no areas are planned for treatment. Therefore the licensee did not account for fertilization treatments in the timber supply analysis. If and when any fertilization treatments are planned and implemented operationally, I will consider the associated impacts in future determinations.

- juvenile spacing

Juvenile spacing was not explicitly accounted for in the analysis. However, based on recommended stocking standards, P&T assumed a regenerating stand density of 1600 stems per hectare (including ingress by natural regeneration) for all managed stands.

I acknowledge the licensee's commitment to assess stands for juvenile spacing based on stocking levels, forest health, site productivity and non-timber management objectives. I also note that as a general rule, juvenile spacing is unlikely to significantly impact stand volume across a wide range of stand densities.

Having reviewed the criteria and assumptions used in the timber supply analysis, I am satisfied that the base case adequately reflects current stocking guidelines and operational practice. I therefore accept them for use in this determination and have made no further adjustments.

- stand conversion treatments

TFL 23 contains approximately 7407 hectares of deciduous-leading stands. As described above under *non-merchantable and low productivity stands*, in the analysis all deciduous-leading stands were removed from the timber harvesting land base. No stand conversion treatments were assumed in the base case and none are planned. District staff confirm that P&T does not harvest a significant amount of deciduous-leading stands nor does operational practice currently include stand conversion treatments.

Having reviewed and discussed the management of deciduous stands on TFL 23 and the approach used in the base case, I am satisfied that the modelling assumptions appropriately represent current operational practice. I therefore accept the base case assumptions as modelled for this determination.

- commercial thinning

Commercial thinning is the harvesting in a maturing stand, of specified trees large enough to be considered a commercial product. While I note that single-entry commercial thinning regimes do not generally increase the yield of specific stands, they can provide

opportunities to harvest timber in areas where harvesting would otherwise be limited to meet a variety of resource objectives.

P&T has not conducted commercial thinning operations on TFL 23 nor has the licensee identified any plans for future commercial thinning opportunities. Commercial thinning was therefore appropriately not modelled in the timber supply analysis. I acknowledge that the timber supply analysis reflects current operational practice and thus have made no associated adjustments to the base case projection for this determination.

- (iv) the standard of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area;**

Utilization standards

Utilization standards define the species, dimensions and quality of trees that must be harvested and removed from an area during harvesting operations. These standards were incorporated into the timber supply analysis for TFL 23 to estimate minimum merchantable stand volume. To derive stand volumes, a 30-centimetre stump height and a 10-centimetre top diameter-inside-bark were assumed in the analysis. For natural stands, the licensee assumed a 12.5-centimetre minimum diameter-at-breast-height (dbh) for lodgepole pine and a 17.5-centimetre dbh for all other species. For managed stands, a 12.5-centimetre minimum dbh for all species was assumed.

For species other than lodgepole pine, I note that provincial standards specify slightly larger minimum breast height diameters compared to those applied to managed stands in the analysis. However, the assumptions applied in the analysis are consistent with current operational practice, and I therefore find them reasonable for use in this determination.

Decay, waste and breakage

In the timber supply analysis, the licensee applied decay, waste and breakage factors for forest inventory zone 'G' as well as loss data specific to the TFL area (Special Cruise #128) to the VDYP growth and yield model used to generate existing stand volumes. The approach was reviewed and accepted for use in this timber supply analysis by staff of the BCFS Resources Inventory Branch.

I consider the estimates for decay, waste and breakage used in the timber supply analysis to reflect the best available information for this area and therefore accept them for use in this determination.

- (v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production;

Integrated resource management objectives

The Ministry of Forests is required under the *Ministry of Forests Act* to manage, protect and conserve the forest and range resources of the Crown and to plan the use of these resources so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are coordinated and integrated. Accordingly, the extent to which integrated resource management (IRM) objectives for various forest resources and values affect timber supply must be considered in AAC determinations.

- non-timber resource inventories and assessments

Non-timber resource inventories have been reviewed and accepted by BCFS regional and district staff and MELP staff. These inventories were used in developing data assumptions for the timber supply analysis as further discussed below under the appropriate sections.

- archaeological sites

An archaeological overview assessment (AOA) was completed in 1995. Impact assessments of the areas identified in the AOA have also been conducted and the results are considered during the forest development planning process. According to the licensee, evidence of historical use has only been demonstrated on one of 98 completed impact assessments. The licensee contends that most known archaeological sites were catalogued prior to completion of the Keenleyside Dam during the 1960s, and now lie below the high water line of the Arrow Lakes reservoir.

At this time I have no specific information that suggests that timber supply on TFL 23 may be affected by archaeological or historical values. To date no sites have been identified that impact the timber harvesting land base. However, additional assessments may be completed in the future. Should the results indicate a need to exclude areas from the timber harvesting land base, the impact on timber supply will be considered in future determinations.

- recreation

A variety of recreational opportunities are available to the public on TFL 23. Popular activities include hunting, fishing, and boating. The licensee's recreation inventories were updated to current BCFS standards in 1998 and have been approved by BCFS Nelson Regional staff. There are 11 road-access recreation sites within TFL 23 as well as approximately 60 kilometres of recreation trails. TFL 23 contains no recreation reserves.

Recreation sites are not permanently excluded from timber harvesting and the licensee appropriately made no deductions to specifically account for recreation. BCFS staff indicate that recreation values have been adequately accounted for in the analysis and I am satisfied that the base case timber supply projection appropriately reflects current management of the recreation resource.

- *wildlife habitat*

TFL 23 supports a great diversity of fish and wildlife species including moose, mule deer, mountain caribou, and black and grizzly bear as well as small mammals, and numerous bird and invertebrate species. The habitat requirements and modelling assumptions for specific species of concern are described below.

- *caribou habitat*

There are two mountain caribou herds that frequent TFL 23: the Monashee herd and the Central Selkirk herd. The Kootenay-Boundary Land Use Plan (KBLUP) implementation strategy identifies a caribou management area that includes part of TFL 23. This area was used to define the caribou habitat zone that was applied in the TFL 23 timber supply analysis. The zone comprises 66 716 hectares of productive forest—approximately 18 percent of the productive forest on TFL 23.

The forest cover requirements assumed for TFL 23 in the analysis varied depending on biogeoclimatic zone and whether the area was identified as operable (see *physical and economic operability*). In the base case the licensee assumed that within the Engelmann Spruce Sub-alpine Fir (ESSF) zone, caribou habitat areas require at least 30 percent of stands to be older than 140 years, and at least ten percent of stands to be older than 250 years. For Interior Cedar Hemlock (ICH) stands, the corresponding assumptions used in the analysis were 40 percent older than 140 years and ten percent older than 250 years. For both the ESSF and ICH components of the caribou habitat zone, no more than 25 percent of the operable area—as defined by the licensee's 1994 operability classification—was permitted to be covered with stands less than two metres tall, and at least 70 percent of the productive forest was required to be greater than 140 years old.

Current management requires that for the ESSF zone, a minimum of 37 percent of the operable land base must be older than 140 years, not the 30 percent assumed in the analysis. Subsequent investigation determined that this additional constraint would not impact the base case harvest forecast for four decades.

P&T proposed a redefined caribou management zone based on field studies conducted during the past five years. The licensee provided a sensitivity analysis to demonstrate the potential impact on timber supply of assuming the redefined caribou management zone. The sensitivity analysis showed that assuming the redefined management zone increases short- and medium-term timber supply by three percent compared to the base case forecast.

I have reviewed the assumptions applied in the base case to account for caribou habitat. I acknowledge that P&T are working in cooperation with MELP and BCFS staff to examine and refine caribou habitat management strategies and their relationship to timber supply. I note that the area of the caribou habitat zone assumed in the analysis is consistent with the area identified in the KBLUP implementation strategy and that at present, this represents an appropriate modelling assumption. However, the forest cover requirements applied to the ESSF component of the KBLUP-derived caribou habitat zone are less restrictive to timber harvesting than indicated by current management and this acts to reduce timber supply in the medium term compared to the base case harvest forecast.

The difference between the assumed and actual forest cover requirements applied to mature forest in the ESSF component of the caribou habitat zone is small (seven percent) and involves a minor proportion of the TFL 23 timber harvesting land base. Nevertheless, I have considered this below in my "Reasons for decision".

- ungulate winter range

In the analysis the licensee identified an ungulate winter range resource emphasis area comprising approximately 36 042 hectares of productive forest on TFL 23. The identified area provides important habitat for mule deer, elk and moose and is based on information from the KBLUP implementation strategy.

Forest cover objectives have been established to provide suitable thermal cover and winter habitat. In the analysis, these objectives were specified by biogeoclimatic unit. To simulate thermal cover requirements, the licensee assumed that within the ungulate winter range areas, at least 40 percent of operable stands occurring in the ESSF and ICH biogeoclimatic zones should be older than 120 years. Within ungulate winter range areas classified as IDF natural disturbance type 4, a minimum of 25 percent of operable area was required to be older than 120 years. Forest cover objectives also required that no more than 25 percent of the operable land base within the ungulate winter range resource emphasis area be covered with stands less than two metres tall.

P&T provided a sensitivity analysis which showed that short- to medium-term timber supply is relatively insensitive to changes in mature forest cover within the ungulate winter range resource emphasis area. Increasing the minimum retention level of stands older than 120 years from 25 to 30 percent decreases timber supply in decades four and five by two to three percent compared to the base case forecast. Decreasing the minimum retention level to 20 percent increases timber supply in decade four by up to eight percent compared to the base case harvest projection.

Having reviewed the timber supply analysis, I am satisfied that the assumptions used to model ungulate winter range adequately reflect current practice. I acknowledge that the forest cover objectives modelled in the base case are consistent with guidelines in the KBLUP implementation strategy. I also note that the ungulate winter range areas assumed in the analysis are not significantly different from those identified by the MAC.

While the forest cover objectives within the ungulate winter range may be further refined in the future, the licensee's sensitivity analysis suggests no significant risk to timber supply and no impact in the short-term compared to the base case projection. I therefore accept the base case assumptions as suitable for the purposes of this determination.

- *identified wildlife*

While the biodiversity and riparian provisions of the Forest Practices Code are intended to provide for the needs of most wildlife species, some species that are considered by MELP to be "at risk" require special management practices. The province's *Identified Wildlife Management Strategy* (IWMS)—released in February 1999—provides direction for managing critical habitat for identified wildlife species that are established through the *Forest Practices Code of British Columbia Act*.

Identified wildlife species are known to inhabit areas within TFL 23. However, specific wildlife habitat areas (WHAs) or management strategies for identified wildlife species have not yet been established on TFL 23. As a result, no explicit measures were applied in the base case to account for identified wildlife.

I note that government has limited the impact of management for identified wildlife over the next two years to a maximum of one percent of the short-term harvest level for the province.

For this determination, it is not possible to specify the exact location or precise amount of habitat area that will be required within the timber harvesting land base to implement the IWMS. However, given the Province's commitment to implementing the IWMS, and given the policy decisions and projected one-percent impact—and noting the expected occurrence of identified wildlife within TFL 23—it is necessary and appropriate to account for an expected but not fully quantified impact on the timber supply. I therefore conclude that timber supply may be up to one percent lower than projected in the base case and have considered this below in "Reasons for decision".

As the province implements its strategy for the management of species at risk, I expect the specific implications to be reflected in future timber supply analyses for TFL 23 and these will be taken into account in future AAC determinations. I encourage the licensee, in cooperation with MELP staff, to begin the identification, inventory and mapping of critical wildlife habitats including those for identified wildlife species. Such information will reduce uncertainty in the management of these species and provide a more accurate assessment of the implications of wildlife management in future timber supply analyses.

- *riparian habitat*

Riparian habitats occur along streams and around lakes and wetlands. The Forest Practices Code requires the establishment of riparian reserve zones (RRZs) that exclude timber harvesting, as well as riparian management zones (RMZs) that restrict timber harvesting in order to protect riparian and aquatic habitats. Stream riparian habitats are

classified S1 to S6 depending on stream channel width, occurrence of fish and the presence of community watersheds.

Formal stream inventories using stream, lake, and wetland classification procedures consistent with Forest Practices Code standards have been completed on approximately 30 percent of TFL 23. Where streams were classified, the licensee multiplied the stream lengths of each stream class by the corresponding width specified in the Riparian Management Area Guidebook to estimate the area of RRZ. This area was excluded from the timber harvesting land base.

For RMZs adjacent to classified streams, lakes and wetlands, the licensee assumed harvesting would remove, on average, 50 percent of the volume within RMZs. To reflect this assumption, P&T permanently excluded half the area of the RMZ from the timber harvesting land base.

To approximate the riparian management areas associated with unclassified streams, the licensee assumed that streams occurring on slopes less than 20 percent were fish-bearing. P&T then derived a weighted-average equivalent zone width (39 metres) based on the deductions for riparian management areas associated with classified streams, lakes and wetlands. The licensee multiplied this average zone width by the estimated length of unclassified fish-bearing streams and excluded the resulting area from the timber harvesting land base.

I have reviewed the licensee's methodology and note a high proportion of the streams within TFL 23 are currently unclassified. However, the licensee's modelling assumptions are based on the best available information and broadly reflect the intent of the Riparian Management Area Guidebook. I therefore accept them as adequate for use in this determination. I acknowledge P&T's commitment to complete the stream inventories during the term of MP No. 9. Any new information including a more precise accounting of harvesting intensity within RMZs will be incorporated into the next determination.

- watershed considerations

TFL 23 contains community and domestic watersheds where the protection of water quality and quantity is of particular concern. Approximately 360 domestic and commercial water use rights and licences have been issued within the TFL area. Areas zoned as domestic watersheds included approximately 30 449 hectares of the timber harvesting land base. The Kootenay Boundary Land Use Plan implementation strategy and an associated Memorandum of Understanding (MOU) between the BCFS and MELP include guidelines for the management of domestic watersheds. Six community watersheds designated under the Forest Practices Code also occur either entirely or partially within TFL 23.

In the timber supply analysis, the licensee assumed forest cover requirements to account for community and domestic watersheds. In the base case, no more than 20 percent of

areas designated as community watersheds may consist of stands less than nine metres tall. For areas zoned as domestic watersheds, the corresponding forest cover requirements assumed in the analysis were 25 percent and six metres. I note these forest cover requirements are consistent with management guidelines identified in the KBLUP implementation strategy.

To protect high value fish bearing streams, MELP staff recommend the application of forest cover objectives to all watersheds without community or domestic watershed status. However this recommendation was not modelled in the timber supply analysis. While interior watershed assessments may be completed for watersheds with particularly high fisheries values, I note that no assessments have been required to date. Moreover, in the analysis additional forest cover may be afforded indirectly as a result of the consideration given to other forest values (e.g., visual quality, riparian areas) in the analysis.

Having reviewed the above information and assumptions, I accept the licensee's base case projection as suitable for this determination, noting that what was modelled reasonably reflects both current practice on the TFL and the provisions of the KBLUP and Forest Practices Code. I request that the licensee work closely with MELP staff through the term of MP No. 9, to refine appropriate management objectives for high value fish streams. Any new information will be incorporated into the next analysis.

- green-up and adjacency

Green-up time refers to the period following harvesting necessary for a regenerating stand to attain a specified condition, expressed in terms of stand height and stocking. Current harvesting practices limit the size and shape of cutblocks, and establish minimum green-up conditions as a means of moderating the effect of additional harvesting in adjacent stands. Adjacency and green-up requirements provide for a distribution of harvested areas and retention of forest cover in a variety of age classes across the landscape.

In the timber supply analysis, P&T modelled adjacency by applying a forest cover requirement to the caribou, ungulate winter range, visual quality, watershed and IRM resource emphasis areas. The licensee assumed that at any given time, no more than 25 percent of the productive land base may consist of stands of trees aged less 15 years. P&T provided a detailed examination using spatial analysis which indicated that timber supply was not limited by additional adjacency considerations during the first two decades. A sensitivity analysis also showed that relaxing the maximum allowable disturbance by five percent has a moderate upward impact—up to seven percent—on medium-term timber supply compared to the base case projection. However, short-term timber supply is highly sensitive to a decrease in the maximum allowable disturbance. Reducing the allowable disturbance reduces timber supply in the second decade by 16 percent compared to the base case harvest forecast.

Having reviewed and discussed the techniques used to model adjacency with BCFS staff, I note that the green-up age assumed in the analysis may be somewhat older than the age

at which stands actually achieve the specified two-metre green-up height permitted by the KBLUP implementation strategy. However, this potential variation does not negatively impact timber supply and I accept the base case projection as adequate for this determination. I note that the licensee intends to expand the use of genetically improved seedlings and this may reduce the age at which green-up height is achieved, thereby increasing harvesting flexibility within the unit. I therefore request that the licensee further refine the modelling and assumptions for adjacency and green-up in time for the next determination.

- visually sensitive areas

Careful management of scenic areas near recreational sites, highways and lakes is an important IRM objective and is part of the BCFS mandate to manage the recreation resource. Procedures which incorporate both biophysical (e.g., slope, topography) and social factors have been developed to describe recommended visual quality objectives (VQOs). VQOs specify the amount of visible disturbance that is acceptable for a given area.

To meet these objectives, constraints must be placed on timber harvesting, road building and other forest practices in visually sensitive areas. The constraints are based on research and experience and on public preferences and acceptance of degrees of alteration of visual landscapes. The constraints are normally expressed in terms of forest cover requirements that relate to the maximum allowable percentage of a viewshed that can be harvested at any one time, and to "visually effective green-up"—that is, the stage at which regeneration has been shown to be visually acceptable to the public.

A visual landscape inventory for TFL 23 was completed in 1998 using accepted BCFS procedures. The inventory includes identification of areas where visual quality is of potential significance. In the timber supply analysis for TFL 23, P&T used this information as well as the KBLUP scenic areas inventory to delineate a VQO zone comprising eight percent (17 132 hectares) of the timber harvesting land base. The zone is comprised of two distinct components: one area, visible from Highways 6 and 23, is located along the east side of the Arrow Lakes between Galena Bay and Fauquier. The remaining area within the VQO zone involves a scenic corridor along the west side of the Arrow Lakes.

In the base case, P&T assumed that no more than 30 percent of each component of the VQO zone was permitted to support stands of trees less than five metres tall. I note that to better reflect operational conditions, the licensee intended to employ a less restrictive forest cover requirement to the portion of the VQO zone along the west side of the Arrow Lakes during the first 20 years of the simulation. However, the licensee was unable to apply this condition because of technical limitations in the computer model. I also note that a small proportion of visually sensitive areas in draft landscape unit R4 (located within the Columbia Forest District) was not fully considered in the analysis. However because of the relatively small area involved, the impact on the TFL 23 base case harvest forecast is negligible.

P&T provided a sensitivity analysis which showed that changing the maximum allowable disturbance within the VQO zone has a significant impact on medium-term timber supply. Increasing the allowable disturbance by five percent increases medium-term timber supply by up to ten percent. By contrast, decreasing the allowable disturbance in the VQO zone by five percent decreases medium-term timber supply by approximately nine percent in decade five.

I have reviewed the base case assumptions and related sensitivity analysis and discussed the implications with BCFS staff. While over the forecast period the assumptions used in the base case reasonably reflect current practice, I note that the licensee intended to model a more realistic, less constraining forest cover requirement in the visually sensitive areas along the west side of Arrow Lakes for the first twenty year period. Having reviewed the information and related sensitivity analysis, and discussed them with BCFS staff, I conclude that medium-term timber supply may be under-estimated by a small amount on account of this factor. I have discussed this further below in my "Reasons for decision".

- biodiversity

Biological diversity, or biodiversity, is defined as the full range of living organisms, in all their forms and levels of organization, and includes the diversity of genes, species and ecosystems, and the evolutionary and functional processes that link them. Under the Forest Practices Code, biodiversity in a given management unit is assessed and managed at the landscape and stand levels.

- landscape-level biodiversity

Achieving landscape-level biodiversity objectives involves maintaining forests with a variety of patch sizes, seral stages, and forest stand attributes and structures, across a variety of ecosystems and landscapes. Managing for biodiversity is based in part on the principle that this—together with other provisions in the Forest Practices Code, such as riparian management, maintenance of wildlife trees, and other forest cover objectives as discussed throughout this document—will provide for the habitat needs of most forest and range organisms.

A major consideration in managing for biodiversity at the landscape level is leaving sufficient and appropriately-located patches of old-growth forests for species dependent on, or strongly associated with, old-growth forests. Although some general forest management practices can broadly accommodate the needs of most species, more often a variety of practices is needed to represent the different natural disturbance patterns under which specific ecosystems have evolved. Natural disturbance types (NDTs) vary from frequent wildfires in the dry interior regions to rare stand disturbance events (e.g., wind) in the wetter coastal regions.

The delineation and formal designation of "landscape units" is a key component of a subregional biodiversity management strategy. A range of biodiversity emphasis options (BEOs) may be employed when establishing biodiversity management objectives for a

landscape unit. The *Biodiversity Guidebook* outlines BEOs—lower, intermediate and higher. If a reasonable distribution of BEOs is maintained across the land base, it is generally considered that biodiversity can be adequately maintained in conjunction with timber harvesting objectives.

The current provincial policy direction provided by the chief forester for assignment of BEOs is to follow guidance provided in the *Biodiversity Guidebook*. The guidebook outlines the proportions of each subregional planning area that should be assigned to each of the three BEOs. The average is approximately 45 percent of the area in lower, 45 percent in intermediate, and 10 percent in the higher BEO. This distribution is believed to provide a balance between social and economic impacts and risk to biodiversity. The policy followed for timber supply analyses when landscape units and BEOs have not been established is to model the distribution of BEOs using a weighted average forest cover requirement which is applied at the biogeoclimatic variant level.

For certain landscape units where old seral forests are in short supply but the economic and social consequences are deemed unacceptable, provincial policy provides for additional harvesting flexibility. In these cases a minimum of one third of the old seral forest retention objective in lower emphasis areas described in the guidebook must be retained initially and the balance recruited over time so that the intended old seral forest retention objective is in place within three rotations.

The Arrow Forest District Manager has established landscape units and BEOs by biogeoclimatic variant for that portion of TFL 23 that lies within the Arrow Forest District (a majority of the TFL). The corresponding seral stage requirements identified in the *Biodiversity Guidebook* were correctly applied in the base case.

For the balance of the TFL which lies within the Columbia Forest District, BEOs have not yet been formally established. Draft objectives have been proposed based on recommendations in the KBLUP implementation strategy and the MAC draft strategy and are currently specified in the Columbia Forest District forest development planning requirements. However, in view of their draft status, the licensee appropriately assumed a weighted-average seral stage requirement based on a 45 percent lower, 45 percent intermediate, and 10 percent higher biodiversity emphasis in these areas.

Consistent with current policy direction, in the base case P&T applied the old seral constraint to lower biodiversity emphasis areas at an initial level of one third the requirement, increasing to the full requirement by the end of the third rotation. The licensee provided a sensitivity analysis to show the impact of applying the full old seral requirement immediately to those landscape units designated as lower biodiversity emphasis as well as to those with the 45:45:10 weighted-average biodiversity emphasis. The sensitivity analysis demonstrated that application of these assumptions resulted in a ten percent reduction in medium-term timber supply compared to the base case harvest forecast. However, short-term timber supply could be maintained for two decades.

Concern was raised that some site series—similar ecological associations within a biogeoclimatic subzone or variant—are not well represented in the inoperable land base and therefore a proportion of the required old seral forest should be maintained within the timber harvesting land base and not be harvested. This concept is often referred to as proportional representation. To respond to this concern I requested that P&T provide sensitivity analyses to explore the implications of proportional representation to the TFL 23 timber supply.

In the sensitivity analyses, the licensee progressively reduced the contribution to old seral stage requirements from areas outside of the timber harvesting land base. The analysis showed that reducing this contribution to 50 percent of the old seral stage requirement—a reasonable proxy for proportional representation—significantly impacts medium-term timber supply compared to the base case projection. However, I note that short-term timber supply could be maintained for up to three decades.

Having reviewed the methodology and assumptions used in the base case and discussed them with BCFS staff, I have concluded as follows: biodiversity objectives were modelled at the variant level and this is consistent with current provincial policy. For the areas within the TFL where landscape units and biodiversity emphasis options are still in draft form, the licensee assumed a 45:45:10 “weighted-average” biodiversity emphasis. As described in “Guiding Principles” I take direction from land use plans that are approved. Although the KBLUP implementation strategy is approved and forest development plans within the Columbia forest district are employing the MAC draft strategy, the identified biodiversity emphasis options are still in draft form. I am therefore satisfied that where the BEOs have not yet been established, the assumptions applied in the base case are consistent with current provincial policy.

I acknowledge that the KBLUP remains unclear on the matter of proportional representation. BCFS staff are uncertain what approach will eventually be taken in the future even though current direction under the Forest Practices Code directs that a non-proportional approach be taken. Although the approach used in the timber supply analysis is consistent with provincial direction, whether it will be practised in the future is currently unclear given the ongoing considerations of the KBLUP and MAC strategy. I note that despite this uncertainty, a sensitivity analysis showed that short-term timber supply could be maintained even if a proportional approach to old seral contributions was applied to TFL 23.

In summary I accept the assumptions applied in the base case because they are consistent with provincial direction on landscape level biodiversity. I am hopeful that by the next determination government will further clarify these issues by considering higher level plan status to certain elements of the KBLUP and MAC strategies.

- *stand-level biodiversity*

Stand-level biodiversity is managed by retaining reserves of mature timber or wildlife tree patches within cutblocks and in adjacent inoperable and other retained areas to provide structural diversity and wildlife habitat.

In the base case for TFL 23, P&T correctly assumed that areas outside of the timber harvesting land base would contribute to stand-level biodiversity requirements. To simulate the requirements of the *Biodiversity Guidebook*, the licensee used computer methods to determine which areas within the timber harvesting land base were more than 250 metres from productive forest areas outside the timber harvesting land base. The licensee then applied procedures in table 20a) of the guidebook to estimate the additional area required for wildlife tree patches. The licensee accounted for this additional area indirectly by applying an average volume reduction of 1.4 percent to the yield tables of all analysis units. BCFS district staff support the assumptions and method used in the analysis.

MELP staff suggest that safety regulations requiring the removal of dangerous trees may degrade the suitability of wildlife tree habitat within riparian management zones. While I acknowledge that removal of dangerous trees may be required in some areas, I note that the retention levels modelled in the base case reflect the maximum basal area retention level (i.e., 50 percent) identified in the *Riparian Management Area Guidebook*. I conclude that regardless of the uncertainty associated with the removal of dangerous trees, the wildlife tree retention level identified in the base case is likely to be well within the suggested range of retention levels identified in the guidebook.

Therefore, having reviewed the analysis and the findings of staff, I accept the assumptions used to account for stand-level biodiversity as modelled and have made no further adjustments.

- (vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber;

Land use planning considerations

The Kootenay Boundary Land Use Plan (KBLUP) provides regional planning guidance to the management of forest and range resources in the Nelson Forest Region. In March 1995, the KBLUP was approved and addressed historic land use uncertainty in the region. The decision also identified 16 new protected areas of which three were located wholly or partially within TFL 23. These areas (Gladstone, Syringa, and Granby Provincial Parks) will help improve representation of protected ecosystems in the region and have since been removed from TFL 23.

As a result of the KBLUP, a number of smaller 'Goal 2' protected areas have also been proposed to protect natural, cultural and recreational features of provincial significance. Approximately 700 hectares within TFL 23 are currently being considered as

'Goal 2' protected areas. I note that because of their relatively small size and the overlap with existing areas of the TFL where harvesting is already restricted (e.g., riparian areas), their removal is unlikely to impact short-term timber supply compared to the base case forecast. If and when these areas are formally designated as protected areas, the impact on timber supply will be examined more precisely in future determinations.

Subsequent work to develop more specific resource management objectives, strategies and guidelines culminated in the KBLUP implementation strategy, approved in July 1997. The KBLUP implementation strategy aims to integrate opportunities for sustainable resource use with sensitive management of environmental values while ensuring that social and community values are respected. The strategy outlines resource management guidelines and objectives for the planning area which includes TFL 23. A Memorandum of Understanding (MOU) between the BCFS and MELP also provides guidance and instruction for the preparation of forest development plans, and includes interpretation around the Code and the KBLUP implementation strategy that are known government direction. The KBLUP implementation strategy also provides guidelines for green-up heights as well as management of domestic watersheds and these were reflected in the licensee's timber supply analysis.

In addition, the Revelstoke and Area Land Use Planning Minister's Advisory Committee (MAC) was formed in September 1995 to make recommendations to government on how the KBLUP should be implemented locally in the Revelstoke area. Draft recommendations were published in October 1997. While I am familiar with the MAC recommendations, I note that the recommendations have not yet been approved by government and until such time, only practices that have been approved and implemented will be reflected in the timber supply analysis.

Overall in making my determination, I have been mindful of the land use planning guidelines affecting TFL 23 and acknowledge that future determinations will reflect ongoing confirmation and clarification of the KBLUP implementation strategy and MAC recommendations.

Twenty-year plan

The main purpose of the 20-year plan is to show if the harvest volume projected in the base case can be spatially configured in specific areas on the landscape over the next 20 years.

P&T employed a computer mapping technique to develop the 20-year plan for TFL 23. Areas proposed for harvest in the existing forest development plan were included in the first five year period of the plan. The standards and practices assumed in the 20-year plan were consistent with those applied in the base case of the timber supply analysis. The plan indicated that the harvest level projected in the base case could be supported over the 20-year period.

The Columbia and Arrow Forest District Managers conditionally accepted the 20-year plan for use in the timber supply analysis. Concerns were expressed that the Shelter Bay area may be unable to support the harvest levels proposed in the 20-year plan given current forest development plan objectives and the use of partial cutting versus clearcutting in these areas. As a result, BCFS Nelson Forest region staff conducted a timber supply analysis of the Shelter Bay portion of the TFL based on information supplied by P&T. Using recommendations in the draft MAC strategy, the analysis confirmed that a harvest of 68 000 cubic metres per year was feasible for the first 20-year period. Additional analyses incorporating a reduced timber harvesting land base, extended regeneration delays in NSR areas, and MAC recommendations also supported this level for at least three decades.

I recognize that it may be difficult for the licensee to distribute the proposed harvest level exactly as configured in the 20-year plan. I am also mindful that the 20-year plan is not an operational plan and recognize that it provides just one alternative distribution of the proposed harvest over time. While there may be harvesting limitations within the Shelter Bay area in the future, a number of analyses undertaken by both the licensee and BCFS staff confirm that the base case harvest projection is attainable for at least the effective period of this determination. I therefore find the 20-year plan acceptable for use in this determination.

Partitioned component of the harvest

The *Forest Act* provides for portions of an AAC to be specified as attributable to different types of timber and terrain in different parts of a TFL. Partitioning an AAC ensures that harvesting is appropriately distributed in forest types, operability classes, or distinct areas.

The current AAC includes a partition to harvest 50 000 cubic metres from areas outside of the operable land base using non-conventional harvest systems. The AAC also includes a partition to harvest 75 000 cubic metres per year from hemlock-leading stands older than 140 years. The intention of these partitions was to provide P&T with an opportunity to demonstrate harvesting performance in these marginally economic areas over the five-year period of MP No. 8.

P&T provided a summary of annual harvesting performance within these two partitions. For the period 1995 to 1998, the licensee achieved an average of 41 percent of the partitioned volume associated with inoperable areas and 81 percent of the partitioned volume associated with older hemlock stands.

I have reviewed the licensee's harvesting performance in these partitions with BCFS district staff. I note that the merchantability of older hemlock stands is subject to changing economic factors and is difficult to predict. Nevertheless, P&T has successfully demonstrated a reasonable level of performance in older hemlock stands (81 percent) and I see no need to include a partition for these stands in this determination.

For stands associated with inoperable areas, a review of P&T's performance suggests that the licensee has had difficulty maintaining operations in these stands over the last four years. The licensee demonstrated in the analysis that those areas classified as 'aerial' (as discussed under *economic and physical operability*) can potentially contribute approximately 56 000 cubic metres per year to the annual harvest on TFL 23 over the forecast period. I have therefore considered a partitioned harvest for these areas and have discussed this further under "Reasons for decision".

- (b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area;**

Alternative harvest flows

The nature of the transition from harvesting old-growth to harvesting second growth is a major consideration in determining AACs in many parts of the province. In the short term, the presence of large volumes of older forest often permits harvesting above the long-term levels without jeopardizing future timber supplies. In keeping with the objectives of good forest stewardship, AACs in British Columbia have been and continue to be determined to ensure that current and medium-term harvest level will be compatible with a smooth transition toward the usually (but not always) lower long-term harvest level. Thus timber supply impacts should remain sufficiently stable so that there will be no inordinately adverse impacts on current or future generations. To achieve this, the AAC determined must not be so high as to cause later disruptive shortfalls in supply nor so low as to cause immediate social and economic impacts that are not required to maintain forest productivity and future harvest stability.

In addition to the base case harvest forecast, the licensee presented two alternative harvest projections. In one alternative, the licensee increased the initial harvest level represented in the base case by five percent while reducing the medium-term forecast. In this alternative a harvest level of 714 000 cubic metres per year was maintained for two decades before declining to a medium-term harvest of 572 000 cubic metres per year.

In a second alternative, the licensee projected a harvest forecast in which medium-term timber supply did not fall below the long-term harvest level. In this alternative, the current AAC could be maintained for a maximum of one decade before declining to the long-term harvest level of 634 000.

I have reviewed the alternatives presented by P&T and observe that the dynamics of timber supply in this unit demonstrates some flexibility in short- and medium-term harvest level. For this determination, I accept the base case harvest forecast based on its indication of stable supply with gradual controlled change and consider it a suitable reference on which to base my determination.

- (c) **the nature, production capabilities and timber requirements of established and proposed timber processing facilities;**

Timber processing facilities

P&T is a North American forest products company specializing in the production of softwood lumber and market pulp. The corporation's wholly owned Canadian subsidiary currently operates sawmills at Midway, Grand Forks and Castlegar. The majority of timber harvested from TFL 23—approximately 500 000 cubic metres annually—is processed by the company's Castlegar sawmill. This represents over 60 percent of the mill's fibre requirements. Chips, sawdust and other mill by-products from the mill are directed to local mills and the licensee's affiliated operation in Halsey, Oregon.

Lower grade pulp logs from TFL 23 are sold to the Celgar Pulp Company in Castlegar as well as Cache Creek Woodchips in Cache Creek. Cedar logs, shakewood and pole grade timber from the TFL are sold or traded to mills in Nakusp and Revelstoke.

To supplement supply, P&T purchases logs from other company operations as well as from private sources in the region. P&T's operations at Midway and Grand Forks do not process significant amounts of timber from TFL 23.

I note the significant contribution of the TFL 23 timber harvest to the licensee's local operations, and have been mindful of this in my determination.

- (d) **the economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia; and**

Minister's letters and memorandum

The Minister has expressed the economic and social objectives of the Crown in two documents to the chief forester—a letter dated July 28, 1994, (attached as Appendix 3) and a memorandum dated February 26, 1996, (attached as Appendix 4). I understand both documents to apply to TFL 23.

This letter and memorandum together include references to forest investments, forest stewardship, a stable timber supply, and allowance of time for communities to adjust to harvest-level changes in a managed transition from old-growth to second-growth forests, so as to provide for community stability.

The Minister stated in his letter of July 28, 1994, that "any decreases in allowable cut at this time should be no larger than are necessary to avoid compromising long-run sustainability." He placed particular emphasis on the importance of long-term community stability and the continued availability of good forest jobs. To this end he asked that the chief forester consider the potential impacts on timber supply of commercial thinning and harvesting in previously uneconomical areas. To encourage this the Minister suggested consideration of partitioned AACs.

As discussed above under Intensive silviculture, P&T do not currently have plans for commercial thinning on TFL 23. I have also reviewed the opportunities for harvesting in previously uneconomical areas, and have concluded that it is appropriate to include in my determination a partition for those areas classified as operable using 'aerial' harvesting methods.

The Minister's memorandum addressed the effects of visual resource management on timber supply. It asked that pre-Code constraints applied to timber supply in order to meet VQOs be re-examined when determining AACs in order to ensure they do not unreasonably restrict timber supply. As discussed under *visually sensitive areas*, I noted that the forest cover requirements for these areas were slightly more restrictive than required and I have considered these impacts in my "Reasons for decision".

Community dependence

The three main communities associated with TFL 23 are Revelstoke, Nakusp and Castlegar. Smaller communities include Trout Lake, Beaton, Burton, Fauquier, Applegrove, Needles, Edgewood and Deer Park.

P&T's Castlegar sawmill employs over 300 persons and the related woodland operations generate approximately 385 person-years of employment annually. I acknowledge the importance of the TFL 23 timber supply on employment and community stability in the region and have considered these in my AAC determination.

Public Involvement

The Minister's letter of July 28, 1994, states that the chief forester should consider important social and economic objectives that may be derived from the public input in the timber supply review where these are consistent with government's broader objectives.

The licensee provided opportunities for public review of the draft statement of management objectives, options, and procedures (SMOOP) and draft MP No. 9 by advertising in local and regional newspapers, conducting an open house and making the documents available for public viewing.

The licensee made suitable efforts to encourage and collect public input. Public response included written inquiries and comments from individuals, the Village of Nakusp and First Nations groups (described further below) and I have considered these in making my determination.

First Nations

The licensee advised 12 First Nations groups of the review process for MP No. 9. P&T further requested input from the Ktunaxa/Kinbasket Tribal Council, Osoyoos Indian Band and Spallumcheen Band on the Statement of Management Objectives, Options and Procedures (SMOOP) and draft Management Plan No. 9. The Ktunaxa/Kinbasket Tribal Council provided a written response and requested consideration of cultural heritage

values, clarification of harvesting statistics, and information on archaeological impact assessments.

I acknowledge the Ktunaxa/Kinbasket Tribal Council's intention to enter into land claims negotiations with the provincial government and understand these discussions to include a portion of the area of TFL 23. As discussed under "Guiding principles", my determination should in no way be construed as limiting the government's legal obligations with respect to First Nations issues. P&T has committed to consult with First Nations as part of regular operations and I note that no specific concerns affecting timber supply have been raised to date. Should future studies or discussions provide new information, any impacts can be reflected in future determinations to the extent that they may affect timber supply.

- (e) **abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.**

Unsalvaged losses

Unsalvaged losses are timber volumes destroyed or damaged by natural causes such as fire, wind, and abnormal impacts from insect or disease and not recovered through salvage operations.

In the analysis, estimates for net losses due to fire, insects and wind amounted to 7100, 13 000 and 3000 cubic metres per year respectively. To account for white pine blister rust, P&T assumed a net loss of 2890 cubic metres year for the first ten decades of the timber supply forecast. After ten decades, the licensee reduced these losses to zero because white pine stands are expected to be less susceptible to blister rust in the future.

Armillaria root rot disease occurs throughout the Nelson Forest Region, however, no specific yield reductions for root rot were assumed in the analysis. I note the licensee has committed to manage susceptible stands according to the Nelson Forest Region procedures to minimize losses.

For this determination, in the absence of better information, I accept the accounting for unsalvaged losses as modelled. Any new information can be incorporated into future analyses.

Reasons for decision

In reaching my decision on an AAC for TFL 23, I have considered all of the factors presented above and have reasoned as follows:

For the reasons stated above in "Timber supply analysis", and from reviewing the considerations as recorded above, I accept the licensee's base case as an adequate basis from which to assess timber supply for the purposes of this AAC determination.

In determining AACs, my considerations typically identify factors which, considered separately, indicate that the timber supply may be either greater or less than that projected in the base case. Some of these factors can be quantified and their impacts assessed with some reliability. Others may influence timber supply by adding an element of risk or uncertainty to the decision but cannot be reliably quantified at the time of the determination. I account for these latter factors in a more general way.

In the determination for TFL 23, I identified the following factors as possible indications of *underestimation* in the projected timber supply, although none is certain nor quantified:

- *site productivity estimates*: based on provincial old growth site index (OGSI) studies as well as the results of sensitivity analyses for TFL 23, I concluded that future yields of regenerating stands and hence timber supply may be underestimated in the long term compared to the base case projection.
- *genetic improvement*: I concluded that the expanded use of improved seed on the TFL is likely to result in higher volume gains than reflected by the three percent genetic gain that was modelled in the base case. While this influences primarily long-term timber supply, increased growth rate of regenerating stands also influences the time taken to reach green-up and minimum harvest age and therefore may also increase medium-term timber supply.
- *visually sensitive areas*: in practice the maximum allowable disturbance within some visually sensitive areas along the west side of Arrow Lakes is greater than was assumed in the base case. I concluded that medium-term timber supply may be underestimated by a small but uncertain amount.

The following two factors were identified as possible indications of *overestimation* in the projected timber supply although neither is certain nor quantified:

- *caribou habitat*: the forest cover objectives that were assumed in the caribou resource emphasis area did not adequately reflect current management practices for maintaining caribou habitat. I concluded that compared to the base case, medium- to long-term timber supply was overestimated by a small amount on account of this factor.
- *identified wildlife*: there was no explicit accounting of the potential impacts of identified wildlife habitat in the base case harvest projection. A number of rare and endangered species are known to occur within the boundaries of TFL 23 and I concluded that their habitat requirements may be inadequately addressed. Current provincial policy on identified wildlife limits provincial impacts to one percent. Accordingly, and in the absence of information specific to TFL 23, I concluded that the corresponding impact on the TFL is up to one percent over the forecast horizon.

In assessing the above factors, I note that all act primarily in the medium to long term, well beyond the effective period of this AAC determination. Although the data I have reviewed do not allow firm quantification, two of the upward pressures on timber supply—namely *site productivity estimates* and *genetic improvement*—are by order of magnitude, significantly larger than those factors acting to decrease timber supply. I considered that those factors contributing to a potential overestimation in timber supply (*identified wildlife* and *caribou habitat*) are more than offset by the combined influences of *genetic improvement* and improved *site productivity estimates*. This, and the fact that they are primarily medium- and long-term issues, leads me to conclude that none of the uncertainties revealed by the analysis will disrupt the base harvest flow over the next five years. In the long term I consider this forecast to be particularly stable.

I acknowledge the ongoing refinements in the operability classification and recognize that the licensee's ability to operate successfully in marginal areas has not been fully demonstrated. As noted under Partitioned component of the harvest, I have decided at this time to set a partition of 56 000 cubic metres per year in areas identified as 'aerial' in the licensee's operability classification. Given the licensee's sensitivity analyses and the modest proportion of the area involved, I am satisfied that this presents no significant risk to the TFL 23 timber supply.

Regarding the KBLUP and the MAC strategies, I believe the licensee has reflected the known components of the plans as well as possible at this time. Confirmation and clarification of management guidelines either in the form of a higher level plan or policy direction will help to remove uncertainty and can be accommodated in future analyses.

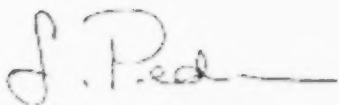
Regarding harvesting activities within the Shelter Bay area, I acknowledge that there may be limited harvesting flexibility within this area and that the availability of timber may be constrained in the future. I note that this determination does not prescribe a specific pattern of harvesting nor attribute volume to specific areas on the TFL. I further recognize that careful planning, consistent with the management objectives for the area, will be required, and I encourage MELP and BCFS staff to work cooperatively with the licensee to develop and apply appropriate silvicultural systems to achieve non-timber objectives.

In summary, my considerations confirm that over the short term, the base case harvest forecast presented by the licensee can be achieved. Having considered and reviewed all the factors documented above, it is my determination that a timber harvest level that accommodates objectives for all forest resources during the next five years, that provides for requirements of the *Forest Practices Code* as they are currently implemented, that ensures integrated resource management objectives can be met, and that meets provincial objectives and avoids disruptive shortfalls in future timber supply can best be achieved in this TFL at this time by maintaining the AAC at 680 000 cubic metres. This AAC includes a partition of 56 000 cubic metres per year for timber stands attributable to the 'aerial' operability class as defined by Figure 3 "TFL 23 Operability Categories" in MP No. 9.

Implementation

This determination is effective August 31, 1999, and will remain in effect until a new AAC is determined, which must take place within five years of the date of this determination. In the period following this determination and leading to the subsequent determination, I request that the licensee perform the following:

- refine the ESA classification of difficult-to-regenerate areas on TFL 23 to identify any areas with potential regeneration concerns, paying particular attention to the areas within the 'aerial' operability class;
- monitor the timber volumes harvested from the 'aerial' operability class to ensure that the operable profile of stands from these areas is adequately represented in the AAC;
- further refine the modelling and assumptions of adjacency and green-up in time for the next determination;
- in co-operation with BCFS staff, update applicable maps and associated records to ensure the respective estimates of the area of Schedule A lands are consistent.



Larry Pedersen
Chief Forester

May 2, 2000

Appendix 1: Section 8 of the *Forest Act*

Section 8 of the Forest Act, Revised Statutes of British Columbia 1996, reads as follows:

8. Allowable annual cut

8. (1) The chief forester must determine an allowable annual cut at least once every 5 years after the date of the last determination, for
- (a) the Crown land in each timber supply area, excluding tree farm licence areas, community forest agreement areas and woodlot licence areas, and
 - (b) each tree farm licence area.
- (2) If the minister
- (a) makes an order under section 7 (b) respecting a timber supply area, or
 - (b) amends or enters into a tree farm licence to accomplish a result set out under section 39 (1) (a) to (d),

the chief forester must make an allowable annual cut determination under subsection (1) for the timber supply area or tree farm licence area

- (c) within 5 years after the order under paragraph (a) or the amendment or entering into under paragraph (b), and
 - (d) after the determination under paragraph (c), at least once every 5 years after the date of the last determination.
- (3) If
- (a) the allowable annual cut for the tree farm licence area is reduced under section 9 (3), and
 - (b) the chief forester subsequently determines, under subsection (1) of this section, the allowable annual cut for the tree farm licence area,

the chief forester must determine an allowable annual cut at least once every 5 years from the date the allowable annual cut under subsection (1) of this section is effective under section 9 (6).

- (4) If the allowable annual cut for the tree farm licence area is reduced under section 9 (3), the chief forester is not required to make the determination under subsection (1) of this section at the times set out in subsection (1) or (2) (c) or (d), but must make that determination within one year after the chief forester determines that the holder is in compliance with section 9 (2).
- (5) In determining an allowable annual cut under subsection (1) the chief forester may specify portions of the allowable annual cut attributable to
- (a) different types of timber and terrain in different parts of Crown land within a timber supply area or tree farm licence area,
 - (b) different types of timber and terrain in different parts of private land within a tree farm licence area, and

- (c) gains in timber production on Crown land that are attributable to silviculture treatments funded by the government of British Columbia, the federal government, or both.
- (6) The regional manager or district manager must determine a volume of timber to be harvested from each woodlot licence area during each year or other period of the term of the woodlot licence, according to the licence.
- (7) The regional manager or the regional manager's designate must determine a volume of timber to be harvested from each community forest agreement area during each year or other period, in accordance with
 - (a) the community forest agreement, and
 - (b) any directions of the chief forester.
- (8) In determining an allowable annual cut under subsection (1) the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider
 - (a) the rate of timber production that may be sustained on the area, taking into account
 - (i) the composition of the forest and its expected rate of growth on the area,
 - (ii) the expected time that it will take the forest to become re-established on the area following denudation,
 - (iii) silviculture treatments to be applied to the area,
 - (iv) the stand of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area,
 - (v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production, and
 - (vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber,
 - (b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area,
 - (c) the nature, production capabilities and timber requirements of established and proposed timber processing facilities,
 - (d) the economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia, and
 - (e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.

Appendix 2: Section 4 of the *Ministry of Forests Act*

Section 4 of the *Ministry of Forests Act* (consolidated 1988) reads as follows:

Purposes and functions of ministry

4. The purposes and functions of the ministry are, under the direction of the minister, to
 - (a) encourage maximum productivity of the forest and range resources in the Province;
 - (b) manage, protect and conserve the forest and range resources of the Crown, having regard to the immediate and long term economic and social benefits they may confer on the Province;
 - (c) plan the use of the forest and range resources of the Crown, so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are coordinated and integrated, in consultation and cooperation with other ministries and agencies of the Crown and with the private sector;
 - (d) encourage a vigorous, efficient and world competitive timber processing industry in the Province; and
 - (e) assert the financial interest of the Crown in its forest and range resources in a systematic and equitable manner.

Documents attached:

Appendix 3: Minister of Forests' letter of July 28, 1994

Appendix 4: Minister of Forests' memo of February 26, 1996



File: 10100-01

JUL 28 1994

John Cuthbert
Chief Forester
Ministry of Forests
595 Pandora Avenue
Victoria, British Columbia
V8W 3E7

Dear John Cuthbert:

Re: Economic and Social Objectives of the Crown

The *Forest Act* gives you the clear responsibility for determining Allowable Annual Cuts, decisions with far-reaching implications for the province's economy. The *Forest Act* provides that you consider the social and economic objectives of the Crown, as expressed by me, in making these determinations. The purpose of this letter is to provide this information to you.

The social and economic objectives expressed below should be considered in conjunction with environmental considerations as reflected in the Forest Practices Code, which requires recognition and better protection of non-timber values such as biodiversity, wildlife and water quality.

The government's general social and economic objectives for the forest sector are made clear in the goals of the Forest Renewal Program. In relation to the Allowable Annual Cut determinations you must make, I would emphasize the particular importance the government attaches to the continued availability of good forest jobs and to the long-term stability of communities that rely on forests.

Through the Forest Renewal Plan, the government is taking the steps necessary to facilitate the transition to more value-based management in the forest and the forest sector. We feel that adjustment costs should be minimized wherever possible, and to this end, any decreases in allowable cut at this time should be no larger than are necessary to avoid compromising long-run sustainability.

.../2

Province of

Minister of

Parliament Buildings
V8V 1X4

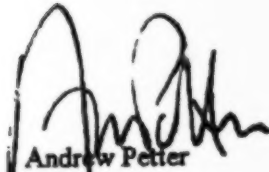


John Cuthbert
Page 2

In addition to the provincial perspective, you should also consider important local social and economic objectives that may be derived from the public input on the Timber Supply Review discussion papers where these are consistent with the government's broader objectives.

Finally, I would note that improving economic conditions may make it possible to harvest timber which has typically not been used in the past. For example, use of wood from commercial thinnings and previously uneconomic areas may assist in maintaining harvests without violating forest practices constraints. I urge you to consider all available vehicles, such as partitioned cuts, which could provide the forest industry with the opportunity and incentive to demonstrate their ability to utilize such timber resources.

Yours truly,



Andrew Petter
Minister



MEMORANDUM

File: 16290-01

February 26, 1996

To: Larry Pedersen
Chief Forester

From: The Honourable Andrew Petter
Minister of Forests

Re: **The Crown's Economic And Social Objectives Regarding Visual Resources**

Further to my letter of July 29, 1994, to your predecessor, wherein I expressed the economic and social objectives of the Crown in accordance with Section 7 of the *Forest Act*, I would like to elaborate upon these objectives as they relate to visual resources.

British Columbia's scenic landscapes are a part of its heritage and a resource base underlying much of its tourism industry. They also provide timber supplies that are of significant economic and social importance to forest industry dependent communities.

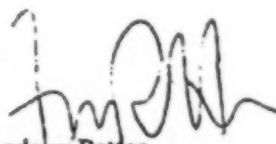
Accordingly, one of the Crown's objectives is to ensure an appropriate balance within timber supply areas and tree farm licence areas between protecting visual resources and minimizing the impact of such protection measures on timber supplies.

As you know, I have directed that the policy on management of scenic landscapes should be modified in light of the beneficial effects of the Forest Practices Code. In general, the new policy should ensure that establishment and administration of visual quality objectives is less restrictive on timber harvesting. This change is possible because alternative harvesting approaches as well as overall improvement in forest practices will result in reduced detrimental impacts on visually sensitive areas. Also, I anticipate that the Forest Practices Code will lead to a greater public awareness that forest harvesting is being conducted in a responsible, environmentally sound manner, and therefore to a decreased public reaction to its visible effects on the landscape. In relation to the Allowable Annual Cuts determinations that you make, please consider the effects that the new policy will have in each Timber Supply Area and Tree Farm Licence.

Larry Pedersen
Page 2

In keeping with my earlier letter, I would re-emphasize the Crown's objectives to ensure community stability and minimize adjustment costs as the forest sector moves to more value-based management. I believe that the appropriate balance between timber and visual resources will be achieved if decisions are made consistent with the ministry's February 1996 report *The Forest Practices Code: Timber Supply Analysis*.

Finally, in my previous letter I had asked that local economic and social objectives be considered. Please ensure that local views on the balance between timber and visual resources are taken into account within the context of government's broader objectives.



Andrew Petter
Minister of Forests